Herbicide Injury Symptoms in Corn

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Systematic diagnosis of abnormalities

- Patterns of distribution at 3 levels:
  - Field
  - Plant
  - "Leaf" or plant part

- Are patterns regular or random?
Field patterns and herbicide injury

- Regular (Field operations)
  - Overlap
  - Compaction
  - Tank contamination
  - Mixing mistake
  - Application error
  - Drift

- Random (Mother Nature)
  - Carryover
  - Drift
  - Topography
  - Weather
  - Plant stress
  - Soil moisture
  - Organic matter/Soil texture
Plant distribution of herbicide injury

- What structures are affected?
  - Cobs (and kernals)
  - Upper leaves
  - Lower leaves
  - Roots
  - Combinations of above

- Structures affected provide clues as to time and source of damage
Plant distribution example
"Leaf" distribution of herbicide injury

- Deformed growth
- Stunting
- Chlorosis
- Necrosis
- Bleaching
- Bending
- Missing kernals
- Red or purple
Leaf (Part) Distribution: Example 1
Herbicide Mode of Action

1. Lipid Synthesis Inhibitors
2. Amino Acid Synthesis Inhibitors
3. Growth Regulators
4. Photosynthesis Inhibitors
5. Nitrogen metabolism
6. Pigment inhibitors
7. Cell Membrane Disrupters
8. Seedling Growth Inhibitors
9. Seedling Shoot Inhibitors
Herbicide Injury Diagnostic Key

When did the injury appear?

A. During or immediately after crop emergence (initial stand not uniform or plants lacked vigor)

B. After crop emergence (initial stand was uniform, plants vigorous)

http://128.104.239.6/uw_weeds/herbinjkey/keystart.htm
A. During or immediately after emergence

Where does the injury appear?

1. Plants stunted & leaves damaged, but roots generally o.k.
2. Plants stunted, leaves damaged, and roots deformed
A. 1. Stunted plants and damaged leaves, but roots o.k.

What type of injury?

a. White or bleached leaves  
b. Chlorotic veins & margins  
c. Deformed leaves
A. 1. a. White or bleached leaves (Pigment inhibitors)

i. Balance Pro (isoxaflutole)

ii. Command, Commit (clomazone)
A. 1. Stunted plants and damaged leaves, but roots o.k.

What type of injury?

a. White or bleached leaves  
b. Chlorotic veins & margins  
c. Deformed leaves
A. 1. b. Chlorotic veins and margins

What part of the leaf is affected (veins or margins)?

i. Margins are chlorotic/necrotic – example: photosynthesis inhibitors, (metribuzin)

ii. Leaf veins are chlorotic or white (tiger striping), lower leaves droop
A. 1. b. ii. Chlorotic leaf veins (Cell membrane disruptors)

Flexstar, Reflex (fomesafen)
A. 1. Stunted plants and damaged leaves, but roots o.k.

What type of injury?

a. White or bleached leaves
b. Chlorotic veins & margins
c. Deformed leaves
A. 1. c. Plants have deformed leaves

How are the leaves deformed?

i. Leaves rolled tightly, some epinasty

ii. Improper leaf unfurling, buggy whipping (grasses more affected)
A. 1. c. ii. Buggy whipping, stunting (Seedling Shoot Inhibitors).

Lasso, Intrro (alachlor); Dual, Cinch (metolachlor); Harness, Surpass (acetochlor); Outlook (dimethenamid)
A. During or immediately after emergence

Where does the injury appear?

1. Plants stunted & leaves damaged, but roots generally o.k.
2. Plants stunted, leaves damaged, and roots deformed
A. 2. Stunted plants, damaged leaves, and damaged roots

What type of injury?

a. Root growth is inhibited with the root tips having a clubbed appearance

b. Plants have pruned roots. The lateral roots are short and slender giving a bottle-brush appearance.

c. Seedling roots are short and thickened with root proliferation.
A. 2. a. Root growth inhibited, clubbed appearance (Seedling Root Inhibitors).

Prowl (pendimethalin), Treflan (trifluralin), Sonalan (ethalfluralin)
A. 2. b. Pruned, bottle brush appearance (ALS inhibitors).

Pursuit (imazapyr); Scepter (imazaquin)
A. 2. c. Stubby, proliferated roots (growth regulators).

2,4-D; Banvel, Clarity (dicamba); Stinger (clopyralid); Tordon (picloram)
Herbicide Injury Diagnostic Key

When did the injury appear?

A. During or immediately after crop emergence (initial stand not uniform or plants lacked vigor)

B. After crop emergence (initial stand was uniform, plants vigorous)

http://128.104.239.6/uw_weeds/herbinjkey/keystart.htm
B. After Crop emergence

What tissue is affected?

1. Older leaves injured; new leaves healthy; CONTACT herbicide

2. New leaves injured; older leaves unaffected; TRANSLOCATED herbicide
B. 1. Contact herbicide

What is the selectivity of the herbicide?

a. Broadleaf weeds more sensitive than grasses.
b. Grasses and broadleaf weeds both affected
B. 1. a. Contact herbicide, selective for broadleaf weeds, consider:

i. Photosynthesis inhibitors
   - Atrazine; Buctril (bromoxynil); Basagran (bentazon)

ii. Cell membrane disrupters (PPO inhibitors)
   - Blazer (acifluorfen); Aim (carfentrazone)
B. 1. a. Contact herbicide, selective for broadleaf weeds, consider:

iii. Pigment inhibitors

iii. Callisto (mesotrione); Impact (topramezone); Laudis (tembotrione)
B. 1. b. Contact herbicide, non-selective

What does the injury look like?

i. Plants suddenly develop water-soaked lesions on exposed leaves, lesions become necrotic.

ii. Plants gradually turn yellow and die.
B. 1. b. i. Contact herbicide, non-selective, rapid lesions; Cell Membrane Disrupters

i. Gramoxone Inteon (paraquat)
B. 1. b. ii. Contact herbicide, non-selective, yellowing, gradual death; Nitrogen Metabolism

ii. Ignite (glufosinate), formerly “Liberty”
B. After Crop emergence

What tissue is affected?

1. Older leaves injured; new leaves healthy; CONTACT herbicide
2. New leaves injured; older leaves unaffected; TRANSLOCATED herbicide
B. 2. Translocated herbicide

What is the selectivity/activity of the herbicide?

a. Broadleaf weeds more sensitive than grasses; leaves of broadleaf weeds become cupped; root deformation on grasses

b. Grasses or broadleaf weeds may be affected. Emerging leaves are chlorotic, growth slows and plants appear stunted.
B. 2. a. Translocated herbicide; affects primarily broadleaf weeds; Growth Regulators

i. 2,4-D; Banvel, Clarity (dicamba); Stinger (clopyralid); Tordon (picloram)
B. 2. b. Translocated herbicides; growing point becomes yellow, growth slows, consider:

i. Lipid synthesis inhibitors - Grass meristems rot and are easily pulled from the whorl

ii. ALS inhibitor – corn stunted, yellow flash in whorl, pinched leaves

iii. Glyphosate – Plants gradually turn yellow and die
B. 2. b. i. Translocated herbicide; grass meristem rots; Lipid synthesis inhibitor

i. Select (clethodim); Poast (sethoxydim); Assure (quizalofop); Fusilade (fluazifop)
B. 2. b. ii. Translocated herbicide; stunting, yellow whorl; ALS inhibitor

ii. Accent (nicosulfuron); Beacon (primisulfuron); Option (foramsulfuron); Pursuit (imazethapyr); Scepter (imazaquin)
B. 2. b. iii. Translocated herbicide; plants gradually yellow and die; EPSP Synthetase Inhibitor

iii. Roundup (glyphosate)
Resource for herbicide injury

- $3.00
- Full color pictures
Resources

- http://www.ridgetownnc.on.ca/services/weeds_herbicide.cfm
- http://ipcm.wisc.edu/uw_weeds/herbinjkey/index.htm
- www.btny.purdue.edu/weedscience/
- Guide for Weed Management in Nebraska http://www.ianrpubs.unl.edu/epublic/live/ec130/build/ec130.pdf
Questions?

Mystery damage
Growth Regulators

- 2,4-D
- MCPA
- Dicamba (Clarity, Distinct, Marksman, etc)
- Clopyralid (Hornet, Stinger)
- Picloram (Tordon, Grazon P+D)
- Quinclorac (Paramount)

Symptoms: buggy whipping, onion leafing, fused or deformed brace rots, goosenecking, brittle stems, missing kernals
Seedling Growth Inhibitors

- Alachlor (Intrro, Lasso, Bullet, Lariat)
- Metolachlor or S-metolachlor (Dual, Bicep II Magnum, Cinch, Stalwart)
- Acetochlor (Harness, Keystone, Degree, Surpass)
- Dimethenamid (Outlook, Guardsman)
- Pendimethalin (Prowl, Pursuit Plus)
- Trifluralin (Treflan)
- Flufenacet (Define)
- EPTC (Eradicane)
- Symptoms: stunted and malformed seedlings, improper leaf unfurling (shepherd's crook), leaf-out underground, reduced root growth, stunted roots, purplish stems and leaves (Treflan, Prowl)
Photosynthesis Inhibitors

- Atrazine
- Simazine (Princep)
- Metribuzin (Sencor)
- Linuron (Linex, Lorox)
- Bromoxynil (Buctril)

Symptoms: leaf tips and margins turn yellow then brown (lower leaves are affected first), interveinal chlorosis, uneven plant height across the field, leaf speckling, contact burn on leaf edges and tips, necrotic lesions (brown spots) on leaves
Lipid Synthesis Inhibitors

- Fluazifop (Fusion, Fusilade)
- Quizalofop (Assure II)
- Clethodim (Select)
- Sethoxydim (Poast Plus)

Symptoms: interveinal chlorosis, red or purple coloration of newer leaves, leaves become chlorotic and die, youngest leaves first, growing point becomes brown and decomposes (separates easily from plant)
Cell Membrane Disruptors

- Paraquat (Gramoxone Inteon)
- Carfentrazone (Aim)
- Sulfentrazone (Authority, Spartan)
- Flumioxazin (Valor)
- Flumiclorac (Resource)
- Fomesafen (Reflex/Flexstar)
- Aciflourfen (Blazer)
- Lactofen (Phoenix/Cobra)

Symptoms: leaf speckling, shepherds crook, silver stripping
Carotenoid Biosynthesis Inhibitors

- Mesotrione (Callisto, Lumax, Lexar, Camix)
- Isoxaflutole (Balance)
- Topramezone (Impact)
- Tembotrione (Laudis)

Symptoms: bleaching of leaves
Amino Acid Synthesis Inhibitors

- **ALS inhibitors**
  - Raptor, Scepter, Pursuit, Option, Permit, Ally, Accent, Beacon, Peak, Steadfast, Harmony, FirstRate, Python

- Symptoms: Yellow flash on leaf whorl, leaves crinkled, new leaves do not unfurl properly (onion-leafing, buggy-whipping), stunting of the plant, purpling of stem and leaves and midrib, roots grow flat or parallel to soil surface, bottle brush appearance to roots, root mass reduced
Amino Acid Synthesis Inhibitors

- **EPSP synthetase inhibitor**
  - Glyphosate (Roundup)
  - Symptoms: injury localized to leaves in whorl at time of application, growing point and leaves slowly turn chlorotic (yellow), localized necrosis of leaf tissue, new growth affected first, reddening and browning of leaves, stunting, wilting and necrosis (death) of entire plant

- **Glutamine synthetase inhibitor**
  - Glufosinate (Liberty)
  - Symptoms: Reddening of leaves at very low rates, chlorosis of leaf tissue, wilting and necrosis (death) of leaves, entire plant